MODEL S-12D

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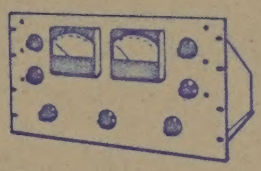

MODEL S-12D
SERVO AMPLIFIER

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TABLE OF CONTENTS

Paragraph *Page*

SECTION 1
DESCRIPTION AND CHARACTERISTICS

1-1 General 1-1
1-2 Purpose 1-1
1-3 Characteristics and Specifications 1-1
1-4 Tube Complement 1-2
1-5 Semiconductor Complement 1-2

SECTION 2
OPERATION

2-1 Preparation 2-1
2-2 Operational Controls 2-1
2-3 Operating Procedure 2-3

SECTION 3
PRINCIPLES OF OPERATION

3-1 Introduction 3-1
3-2 Circuit Description 3-1
3-3 Power Supply 3-2

SECTION 4
MAINTENANCE

4-1 Calibration 4-1
4-2 Hum Adjustment 4-3
4-3 Troubleshooting 4-3
4-4 Other Difficulty 4-4

SECTION 5

Replaceable Parts Lists 5-1

SECTION 6

Master Schematic Model S-12 Servo System ..... Envelope

LIST OF ILLUSTRATIONS

Figure *Page*

SECTION 3

3-1 Model S-12 Servo Amplifier, Simplified Schematic 3-5

SECTION 4

4-1 Model S-12 Servo Amplifier, Front View 4-4
4-2 Model S-12 Servo Amplifier, Front View 4-5
4-3 Model S-12 Servo Amplifier, Bottom View 4-5

SECTION 1

DESCRIPTION AND CHARACTERISTICS

1-1. GENERAL

The Ling Electronics Model S-12 D & G Servo Amplifier (hereafter referred to simply as the S-12) is one component chassis of a servo system used in vibration-testing work to maintain one or more vibration quantities constant at an electronically-driven shaker. Depending on the configuration of the servo system, one or more S-12 units may be used in a particular application, in combination with one or more selectors to permit control on one of the outputs of the S-12 units. The S-12 accepts input signals proportional to shaker velocity, and produces from these output signals and meter readings proportional to both displacement and acceleration; the S-12 also accepts input signals proportional to shaker acceleration, and produces an output and a meter reading proportional to acceleration.

1-2. PURPOSE

Purpose of the S-12 is to meter, and supply an output for control purposes, the quantities of displacement and acceleration in periodic vibration-testing systems.

1-3. CHARACTERISTICS AND SPECIFICATIONS

All components of the S-12, including power supply, are contained in one rack-mounting chassis 15 inches deep, 19 inches wide, and with panel height 10½ inches. The front panel contains two separate meters, one for displacement and one for acceleration, G and D multiplier switches, V and G transducer selector switches, G and D output level controls, and a function switch selecting the mode of operation for the servo with which the S-12 is used. Connections are made to both plugs (for transducers) and terminal strip on the rear of the chassis.

Specifications for the S-12 are as follows:

Power requirements	115 v ac, 60 cps, 55 watts.
Input transducer	Velocity (for G and D) or Acceleration (for G only)
Input signal	68.1 mv rms per in/sec peak velocity or 1. to 10 mv rms per G peak acceleration
Input impedance	Velocity, 1.0 megohm Acceleration, 100K
Ranges	Displacement, 0.01 - 0.10 inches da or 0.10 - 1.0 inches da

	Acceleration, 1.0-10 G peak, or 10-100 G Peak
Servo output	Normal signal, 0.7v rms; into load impedance of 100,000 ohms or higher
Accuracy	± 5% rms of full scale
Frequency range	3 - 5000 cps
Size	Panel, 10½" x 19" Chassis, 15" deep x 17" wide
Weight	30 pounds

1-4. TUBE COMPLEMENT

REFERENCE SYMBOL	TYPE	FUNCTION
V1	6SL7GT	Input amplifier, G channel from velocity pickup
V2	6SL7GT	G channel amplifier
V3	6SL7GT	G channel amplifier and cathode follower
V4	6SL7GT	Input amplifier, D channel from velocity pickup
V5	6SL7GT	D channel amplifier and cathode follower
V6	5Y3GT	Rectifier, power supply
V7	OC3	Reference tube, voltage regulator
V8	6SH7	Regulator amplifier tube
V9	6Y6G	Regulator series tube
V10	OB2/VR105	Regulator tube

1-5. SEMICONDUCTOR COMPLEMENT.

REFERENCE SYMBOL	TYPE	FUNCTION
CR1	1N54	Meter rectifier, G
CR2	1N54	Meter rectifier, G

CR3	1N54	Meter rectifier, D
CR4	1N54	Meter rectifier, D
CR5	1N54	Linearity correction
CR6	1N54	Linearity correction
CR7	10F1	Filament rectifier
CR8	10F1	Filament rectifier
CR9	10F1	Filament rectifier
CR10	10F1	Filament rectifier

SECTION 2
OPERATION

2-1. PREPARATION

The S-12 is shipped with all tubes in place and ready to operate. A visual inspection should be made after unpacking, for evidence of any shipping damage or for loose knobs, tubes or components.

The S-12 is designed for rack mounting, and is installed according to the instructions applicable to the system with which it is to be used. Connections are made to plugs and to a terminal strip on the rear of the chassis. Connections are as follows:

Plugs	J1	Velocity pickup, Cannon XL connector
	J2	Velocity pickup, Cannon XL connector
	J3	Accelerometer (via external cathode follower) Cannon XL connector
	J4	Accelerometer (via external cathode follower) Cannon RWK-6 connector
Terminal Strip	1	Chassis ground
	2	Circuit ground
	3	115 v ac
	4	115 v ac
	5	Circuit ground
	6	D output to servo or selector
	7	G output to servo or selector
	8	Input from selector (D or G)
	9	Circuit ground
	10	AGC output to servo (from function switch on S-12)
	11	Spare
	12	Spare

Connections to plugs J1, J2 and J3 are pin 1, circuit ground. Double-shielded cable is recommended, with inner shield tied to pin 1 and outer shield tied to pin 3. J4 has additional connections for B+ to accelerometer preamplifier (see Figure 3-1).

The S-12 is factory calibrated for an input signal of 1 to 10 mv rms/peak G at the acceleration inputs, and 68.1 mv rms per in/sec peak at the velocity inputs. The acceleration input is normally supplied from an external amplifier or cathode follower (such as the Ling Model CF-3). If transducers having different sensitivities than those quoted are to be used, then the calibration of the S-12 must be changed (if within 10% of original setting) or external amplification or attenuation provided.

2-2. OPERATIONAL CONTROLS

All operational controls for the S-12 are located on the front panel. Panel-mounted components are as follows:

M1 Displacement meter. Rectangular-cased panel meter with an illuminated scale calibrated 0.1 - 1.0, corresponding to displacement readings of 0.01 - 0.1 or 0.1 - 1.0 inches da, depending on range-switch setting.

M2 Acceleration Meter. Rectangular-cased panel meter with an illuminated scale calibrated 5-50, corresponding to acceleration readings of 0.5 - 5 G or 5 - 50 G peak, also 1.0-10G, 10-100G depending on range-switch setting.

S5 Displacement range switch. Two-position switch reading D X 0.1 and D X 1.0, selecting the multiplying factor for the displacement-meter scale.

S4 Acceleration range switch. Four-position switch reading 5, 10, 50, and 100, selecting the multiplying factor for the acceleration-meter scale.

S2 Velocity pickup selector. Two-position switch selecting either of two velocity pickups connected to J1 and J2.

S3 Accelerometer selector. Three-position switch selecting either of two accelerometer inputs connected to J3 and J4, or differentiated velocity from velocity pickup selected by velocity pickup selector.

S1 Function switch. Four-position switch selecting the mode of servo operation as manual (servo AGC input grounded); D (servo AGC acting on displacement only); G (servo AGC acting on acceleration only); or AUTOMATIC (servo acting on D or G, as selected external to the S-12).

R39 Displacement level control. Potentiometer setting output level on D channel. Rough calibration on panel, reading .04-.8 inches da.

R22 Acceleration level control. Potentiometer setting output level on G channel. Rough calibration on panel, reading 5-50 G peak.

2-3. OPERATING PROCEDURE

The S-12 is powered by a-c power from switches or circuit breakers external to the unit; there is no power switch on the S-12. After power is applied, allow at least a five-minute warmup period before commencing operation.

Since the S-12 is normally a part of an over-all servo system, its operation is in conjunction with the other units of that system. Accordingly, the operating procedure to be followed is that perscribed in the instructions for the particular servo system with which it is used, and only general comments will be included in this manual.

Operating controls on the S-12 in general establish the operating level of vibration (displacement or acceleration) for the shaker when the servo is operating, and select the mode of operation of the servo. The servo will control on a given METER READING on the S-12, so that if the range switch (D or G) is changed, the level of vibration will automatically change by a calibrated factor if the servo is operating and controlling on that particular quantity.

It is advisable not to change any switch settings or other controls, except the output controls for D and G, while the power amplifier is turned on. This is a precaution to avoid introducing switching transients and thumps into the system that might damage the shaker and/or specimen or produce shutdown of the amplifier.

Operation of the S-12 with a random signal is not recommended, as accuracy will be seriously affected. The S-12, and the servo systems with which it is used, are designed for sinusoidal vibration-testing. The acceleration meter, however, when used with accelerometer input, may be used for random signals by multiplying the scale reading by 0.8 to obtain the rms value of the random acceleration signal; accuracy of this method depends on the bandwidth used, and deteriorates for narrow bandwidths.

The S-12 is designed so that a velocity transducer will produce both displacement and acceleration readings and outputs, and normal usage of the S-12 is with this type of transducer. Some tests, however, are more conveniently conducted using an accelerometer. Two accelerometer inputs are provided for in the S-12, and the G channel may be switched to either of these inputs. Factory calibration of each of these inputs is on the basis of 1 mv rms per G peak; however, accelerometers having other calibrations may be used if the S-12 is readjusted. Potentiometer-type controls R48 and R49 have been conveniently located on the rear of the S-12 chassis as screwdriver adjustments for attenuation in the accelerometer channel. R48, the top adjustment, controls the attenuation from input connector J3 and goes with the ACCELEROMETER 1 position of selector switch S3, located in the center of the front panel just below the two meters. R49, the bottom adjustment, goes with connector J4 and the ACCELEROMETER 2 position of S3.

To set the accelerometer adjustments, the vibration-testing system may be set manually for a vibration level of, say, 5 G at a frequency of 100 cps. With the accelerometer mounted directly on the shaker table and connected via a cathode follower or isolating amplifier to input connector J3 or J4, the potentiometer (R48 or R49) corresponding to the input selected (J3 or J4) may be adjusted so that the G meter reading is the same with S3 switched to the proper position (ACCELERATION 1 or 2) as with S3 switched to the DIFFERENTIAL VELOCITY position. This procedure of course assumes that the system is set up and operating currently with a velocity pickup as the normal input. The accelerometer is now calibrated and may be mounted on the test specimen or fixture. In the event that the accelerometer sensitivity is insufficient to produce the required voltage, additional amplification will be necessary external to the S-12.

SECTION 3

PRINCIPLES OF OPERATION

3-1. INTRODUCTION

The Ling Model S-12 D and G Servo Amplifier (referred to simply as the S-12) is a device to measure acceleration and displacement in vibration-testing systems, and to provide an output of each of these quantities for control applications. The S-12 is normally used as a part of the Ling Model S-11 Servo System one of its several configurations, and is the component which supplies the control signal to the main servo control amplifier of the servo system. The S-12 is normally used with a velocity transducer, but provision is made also for an accelerometer for the G channel (not for displacement).

3-2. CIRCUIT DESCRIPTION

Fig. 3-1 is a schematic diagram of the S-12D, which is the most recent version of the equipment (as of Spring 1960). Differences between this latest version and prior models are minor, and relate mainly to change in values of a few components, and the addition of two ranges in G selection.

The S-12 has two main channels, one for acceleration (G channel) and one for displacement (D channel). The G channel is shown in the upper portion of Fig. 3-1. Either of two velocity pickups is selected by transducer selector S2, located on the front panel of the instrument, and the signal from the transducer so selected is applied simultaneously to the G channel and the D channel. V1A is the input amplifier for the G channel, followed by a cathode follower V1B. At the output of V1B, a differentiating network C3/R8 with a -3 db cutoff of 24000 cps produces a signal proportional to acceleration over the frequency range of interest. This signal, or one exactly proportional to acceleration as obtained from either of two accelerometers that may be connected to input plugs J3 and J4, is selected by selector switch S3, also located on the front panel. The selected signal is amplified by a gain-stabilized amplifier consisting of V2 and V3A. Gain stabilization, and gain control, is produced by negative feedback from the cathode of V3A back to the cathode circuit of V2A, via resistor R55 in shunt with switch S4, and potentiometer R12. The settings of R12 and R55 establish the gain of the amplifier, and the gain in two positions of S4, respectively. With R55 shorted out by S4 in the 50 and 100 G position, maximum feedback is applied, which results in minimum amplifier gain; with R55 not shorted (S4 in the 5 or 10G position) the amplifier gain is increased by a factor of exactly 10 (when properly adjusted) due to the reduction in feedback. The output of this gain-stabilized amplifier is applied to cathode follower V3B, which drives both the metering circuit and the output.

The D channel is similar in operation to the G channel, except that an integration must be performed in order to obtain displacement from velocity. This integration is made at the input to the D channel by resistor R24 and capacitor C9, acting as a low-pass filter with -3 db cutoff frequency of about 0.3 cps. The integrated signal, now proportional to displacement over the frequency range of interest is amplified by gain-stabilized amplifier V4 and V5A. This amplifier is identical to the G-channel gain-stabilized amplifier, except for the including of resistor R32 in the feedback path, to increase the minimum gain slightly over that of the G-channel amplifier. As

with the G channel, output is taken from cathode follower V5B to supply the metering circuit and the output.

The metering circuits in both D and G channels operate in the same way, and differ only in the choice of component values to achieve the correct degree of meter linearity and range. Each meter circuit is capacity coupled to the cathode-follower output, via C22 in the G channel and C7 in the D channel. Type 1N54 diodes are used as a full-wave rectifier so that current flows through the meter on both half cycles of the applied voltage. Potentiometers R54 and R52, mounted on the chassis as screwdriver adjustments, control the meter sensitivity and establish the range of current corresponding to full-scale meter deflection. Resistors R15 and R41, in combination with 1N54 diodes CR5 and CR6, respectively, also shunt the meter circuit and correct for non-linearity of the rectifier diodes. Resistors R15 and R41 are given in Fig. 3-1 as nominal values; the exact value is selected at the factory for each S-12 unit, and depends on the meter and other components in the meter circuit. Capacitors C27 and C28 filter the higher frequency components of rectified signal. Each meter circuit responds to the average value of the input signal from its respective cathode follower, and is calibrated to read peak (G) or peak-to-peak (D) of a sine wave. With non-sinusoidal waves, the meter reading will be in error by an amount depending on harmonic content.

The output circuit is via panel-mounted potentiometers R22 and R39 for G and D channels, respectively. S1 is the function switch, having four positions of MANUAL, D, G and AUTOMATIC. In MANUAL position, the AGC line to the servo control amplifier is grounded, so that no servo operation can take place and gain must be adjusted manually. In G or D position, the AGC line is switched to G or D outputs, respectively. In AUTOMATIC position, the AGC line switched to the output of an external selector, such as the Ling Model DA-10B, which chooses one of two or more D or G signals for control purposes.

3-3. POWER SUPPLY

The power supply for the S-12 is an integral part of the unit, and is shown in the lower portion of Fig. 3-1. The supply is a conventional full-wave rectifier V6, supplied from transformer T1. A capacitor-input, two-section filter is used, followed by an electronic voltage regulator consisting of series regulator tube V9, amplifier V8, and reference tube V7. A portion of the screen voltage for V8 comes via resistor R64 from the unregulated side of the supply, as a means of improving the regulator performance for ripple or other input-voltage variations. C20 also bypasses the output voltage divider to increase the loop gain of the regulator for ripple and higher frequencies, thus improving the regulation. The supply is designed for an output voltage of 230 volts. Plate voltage for the last two stages of the D-channel amplifier, V5A and V5B, is taken from the unregulated side of the power supply via decoupling circuit R60 and C15, since these two tube sections require slightly higher plate voltage to produce the voltage swing required, without generating distortion or non-linearity.

An auxiliary output of either 105 or 150 volts DC is furnished by V-10, OB2 for 105 V and 0A2 for 150 V, pin 4 of J2, for powering external power to an accelerometer preamplifier. A filament rectifier and filter (CR 7-10, C21, R69 and C24) supplies an adjustable 6-volt DC output to pin 1 or J4 for preamplifier used.

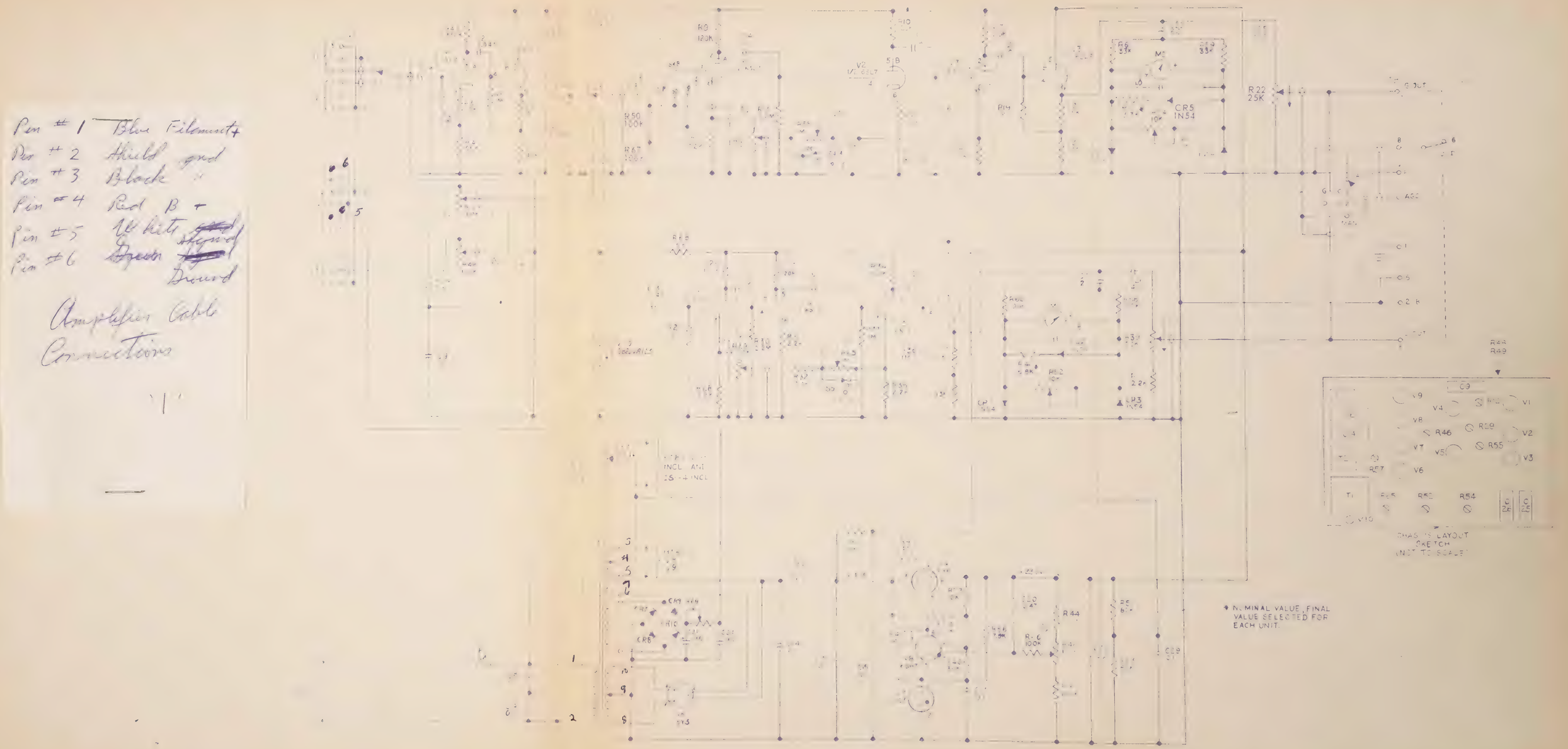

Figure 3-1 Model S-12 Servo Amplifier, Simplified Schematic

SECTION 4

MAINTENANCE

4-1 CALIBRATION

The S-12 is factory calibrated and should not require recalibration except in the event of replacement of tubes or parts. To calibrate the instrument, proceed as follows:

1. After applying power to the unit, allow at least a 15-minute warmup.
2. Measure power-supply voltage with an accurate voltmeter, and set to 230 volts by adjusting R46, located on the chassis between V7 and V8.

3. Establish the following control settings:

Velocity transducer selector	S2	Position 1
Accelerometer selector	S3	DIFFERENTIAL VELOCITY
Function switch	S1	G
D range switch	S5	1.0
G range switch	S4	50
D output control	R39	0.04
G output control	R22	5

4. Connect an oscillator, with suitable output meter or accurate VTVM capable of reading voltages in the range 0.1 to 2.0 volts rms, to input connector J1. Signal connects to pin 2; shield to pin 1. Adjust oscillator to produce a voltage of 210 millivolts rms at a frequency of 100 cps.

5. Connect a suitable a-c voltmeter, such as a VTVM, to terminal TB1-10, with shield on TB1-9. Voltmeter should be able to read voltages between 0.5 and 10 volts rms, in the audio range.

6. Adjust potentiometer R12, located on the chassis between V1 and V4, for 0.7 volt rms output voltage at TB1-10.

7. Adjust potentiometer R54, located on the chassis near G meter M2, until the G meter reads 5 G.

8. Switch the G range switch S4 G X 5.0G position.

9. Adjust potentiometer R55, located on the chassis between V2 and V5, for 7.0 volts rms output voltage at TB1-10.

10. The G meter should read between 47.5 and 52.5 G at this time. If it does not, then readjust R54 for full-scale reading of between 47.5 and 52.5; then return S4 to the G X 50 position and adjust the meter zero-set screw for a reading of 5 G. Repeat steps (8) through (10) until the proper readings

are obtained at both ends of the scale.

Note: The meter used here has a suppressed zero, logarithmic movement. In this circuit the zero adjustment and the shunt diode and resistor are used to compensate for the rectifier diode linearity. Therefore it will not be possible to calibrate the movement by itself. Further care should be taken to avoid

11. Set the function switch S1 to D position.
12. Readjust oscillator for 0.855 volt rms at 100 cps.
13. Adjust R29, located on the chassis between V4 and V5, for 0.7 volts at TB1-10
14. Readjust oscillator for 2.138 volts rms at 100 cps.
15. Adjust R39, the D output control on the front panel, for 0.7 volt rms at TB1-10.
16. Adjust R52, located on the chassis near meters M1 and M2, until the D meter reads 0.1 within 5%.
17. Switch the D range switch S5 to the D X 0.1 position.
18. Adjust potentiometer, located on the chassis near meter M1, for 7.0 volts rms at TB1-10.
19. The D meter should read between 0.95 and 1.05 at this time. If it does not, readjust R52 for full-scale reading; then return S5 to the D X 1.0 position and adjust the meter zero-set screw for a reading of 0.1. Repeat steps (17) through (19) until the proper readings are obtained are both ends of the

20. As a check on the calibration and linearity, the following meter readings and output voltages should be obtained within 5% at the oscillator voltages and frequencies specified:

A. G Calibration

Frequency Cps	Input Voltage rms	Output Voltage rms	G Meter Reading	S4 Setting
25	0.336	2.8	2	5
25	1.68	1.4	10	50
100	0.84	2.8	20	50
500	0.252	4.2	30	50
2000	0.084	5.6	40	50

B. D Calibration RETURN R39 TO MIN SET FRONT PANEL

Frequency cps	Input Voltage rms	Output Voltage rms	D Meter Reading	S5 Setting
10	0.4276	3.5	0.2	X1.0
25	1.069	3.5	0.2	X1.0
100	1.71	14.0	0.08	X0.1

4-2. HUM ADJUSTMENT

Potentiometer R57, located on the chassis near filament transformer T2, is a hum adjustment connected in the heater circuit for tubes V1 through V5. To set this adjustment, short input at J1. Connect a sensitive VTVM or oscilloscope to TB1-10 (signal) and to TB1-9 (shield), and set to read 10 millivolts rms. With power supplied to the S-12 unit and all controls set as in Step 3 of the calibration procedure (paragraph 4-2), adjust R57 for minimum hum output, which should be less than 7 mv, rms. EXCEPT FUNCTION SWITCH SHOULD BE IN "D" POSITION

4-3. TROUBLESHOOTING

The following are suggested causes and/or remedies for troubles that might occur in the S-12.

TROUBLE	REMEDY AND/OR CAUSE
Unit does not come on when power is applied	Check fuse F1
Fuse F1 blown	Check for cause of fuse blowing; possible bad rectifier tube V6, blown filter capacitor C14 or C16, or short-circuit in power supply or power transformer
Power-supply voltage will not regulate and adjust to 230 volts	Check reference tube V7 Check regulator amplifier V8 Check series regulator V9 Check for excessive drain on supply, as for example by blown capacitor C30 or C15. The latter will be indicated by excessively hot resistor R60 Check for open potentiometer R46
Meter reading highly non-linear	Check diodes CR5 or CR6, for meter affected Check meter rectifiers CR1 and CR2, or CR3 and CR4, for meter affected
Distortion or low gain	Check tubes; V1-V3 in G channel, V4-V5 in D channel Check power-supply voltage
G accuracy out of tolerance	Check G channel tubes Check differentiating network C3/R8
D accuracy out of tolerance	Check D channel tubes Check integrator R24/C9

4-4. OTHER DIFFICULTY

In the event of troubles or problems not covered by this manual or by standard troubleshooting procedures for electronic equipment, contact the factory, giving serial number of unit, conditions of use, and full description of the problem. Ling field service personnel are constantly available for consultation on special problems concerning utilization or application of Ling equipment, and upon making the necessary arrangements, can be on the scene within 24 hours.

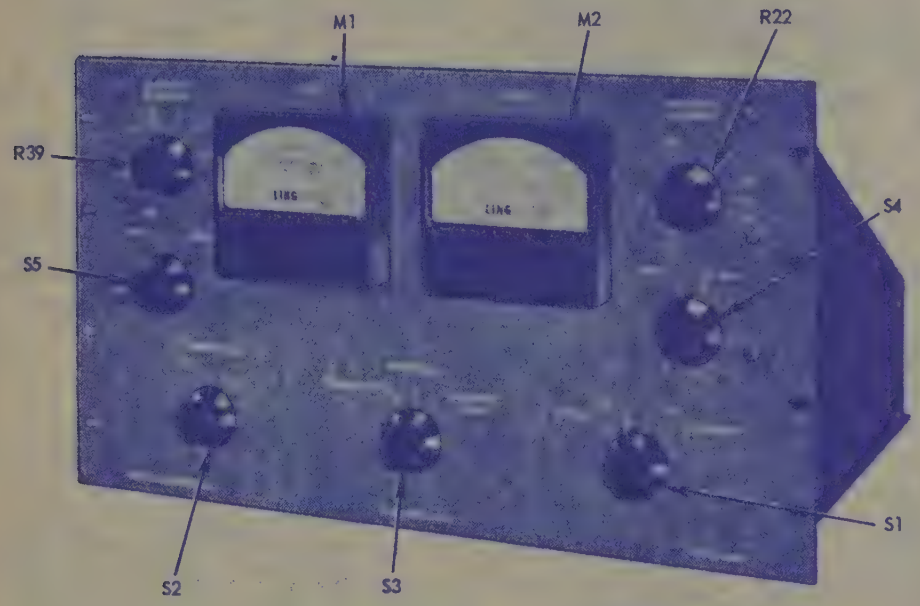

Figure 4-1 Model S-12D Servo Amplifier, Front View

SECTION 5
REPLACEABLE PARTS LIST

REPLACEABLE PARTS LIST

S-12-D SERVO AMPLIFIER SERIAL NO._____

SCHEMATIC DESIG.	DESCRIPTION			MANUFACTURER (SEE CODE) AND MANUFACTURER'S PART NO.
C1	Capacitor	Mylar paper	.047 mfd 400 V	SP - 4TM-S47
C2	Capacitor	Mylar paper	.047 mfd 400 V	SP - 4TM-S47
C3	Capacitor		.001 mfd 500 V 5%	SA - CR1210
C4	Capacitor		1.0 mfd 1 KV	GE - 23F446 (No Strap)
C5	Capacitor	Mylar paper	0.1 mfd 400 V	SP - 4TM-P1 FY - 111-4P1
C6	Capacitor	Mylar paper	0.1 mfd 400 V	SP - 4TM-P1 FY - 111-4P1
C7	Capacitor	Metalized paper	2.0 mfd 400 V	HP - 2PD4
C8	Capacitor		0.1 mfd 400 V	FY - 111-4P1
C9	Capacitor		10 mfd 400 V	GE - 23F703-G103
C10	Capacitor		1.0 mfd 1 KV	GE - 23F446 (No Strap)
C11	Capacitor	Mylar paper	0.1 mfd 400 V	SP - TMP1 FY - 111-4P1
C12	Capacitor	Mylar paper	0.1 mfd 600 V	SP - 6TMP1 FY - 111-6P1
C13	Capacitor	Paper	0.47 mfd 600 V	WP - 18M6474-1
C14	Capacitor		10 mfd 600 V	GE - 23F876-G103
C15	Capacitor		10 mfd 400 V	GE - 23F703-G103
C16	Capacitor		10 mfd 600 V	GE - 23F876-G103
C17	Capacitor	Mylar Paper	0.1 mfd 400 V	SP - 4TM-P1 FY - 111-4P1
C18	Capacitor		0.1 mfd 600 V	SP - 6TM-P1 FY - 111-6P1
C19	Capacitor		0.1 mfd 600 V	SP - 6TM-P1 FY - 111-6P1
C20	Capacitor	paper	0.47 mfd 600 V	WP - 18M6474-1
C21	Capacitor	Electrolytic	1000 mfd 12 V	CD - BRH-1210
C22	Capacitor		6 mfd 600 V	SA - 7106-6-OR
C23	Capacitor	paper	0.47 mfd 600 V	WP - 18M6474-1
C24	Capacitor	Electrolytic	1000 mfd 12 V	CD - BRH-1210
C25	Capacitor		10 mfd 400 V	GE - 23F703-G103
C26	Capacitor		4mfd 400 V	GE - 23F700-G103
C27	Capacitor	Metalized	1.0 mfd 400 V	HP - 1P4D
C28	Capacitor	Metalized	1.0 mfd 400 V	HP - 1P4D
C29	Capacitor	Mylar	0.1 mfd 400 V	FY - 111-4P1 SP - 4TM-P1
C30	Capacitor	Metalized	2mfd 400 V	HP - 2P4D
C31	Capacitor	Metalized	2 mfd 400 V	HP - 2P4D
CR1	Diode	Germanium	1N54	HY
CR2	Diode	Germanium	1N54	HY
CR3	Diode	Germanium	1N54	SY
CR4	Diode	Germanium	1N54	HY
CR5	Diode	Germanium	1N54	HY
CR6	Diode	Germanium	1N54	SY
F1	Fuse	3AG	2 Amp. 250 V	LI
CR7	Diode	Silicon	10 - F1	AD
CR8	Diode	Silicon	10 - F1	AD
CR9	Diode	Silicon	10 - F1	AD
CR10	Diode	Silicon	10 - F1	AD
J1	Connector	Input		CAN XLR-3-13
J2	Connector	Input		CAN XLR-3-13
J3	Connector	Input		CAN XLR-3-13
J4	Connector	Input		CAN RWK-6-31SL

S-12-D SERVO AMPLIFIER (Cont'd) SERIAL NO._____

SCHEMATIC DESIG.	DESCRIPTION			MANUFACTURER (SEE CODE) AND MANUFACTURE'S PART NO.	
L1	Choke		10 Hy at 90 MA	T	C7X
M1	Meter	Log Movement	100 ma	WES	Model 861
M2	Meter	Log Movement	100 ua	WES	Model 861
R1	Resistor	Composition	2.2 K 1/2 W 10%	AB	
R2	Resistor	Composition	1 Meg 1/2 W 10%	AB	
R3	Resistor	Composition	7.5K 1 W 5%	AB	
R4	Resistor	Composition	56 K 1 W 5%	AB	
R5	Resistor	Composition	1 Meg 1/2 W 10%	AB	
R6	Resistor	Composition	1 K 1 W 10%	AB	
R7	Resistor	Composition	68 K 1 W 10%	AB	
R8	Resistor	Composition	6.8 K 1/2 W 5%	AB	
R9	Resistor	Composition	120 K 1 W 10%	AB	
R10	Resistor	Composition	120 K 1 W 10%	AB	
R11	Resistor	Composition	2.2 K 1 W 10%	AB	
R12	Potentiometer	Linear Taper	10 K 2 W	O	CLU-1031
R13	Resistor	Composition	2.2 M 1/2 W 10%	AB	
R14	Resistor	Composition	2.2 K 1 W 10%	AB	
R15	Resistor	Composition	3.3K 1 W 10%	AB	
R16	Resistor	Composition	1 Meg 1/2 W 10%	AB	
R17	Resistor	Composition	120 K 1 W 10%	AB	
R18	Resistor	Composition	2.2 K 1 W 10%	AB	
R19	Resistor	Composition	1 Meg 1/2 W 10%	AB	
R20	Resistor	Composition	1.5 K 1 W 10%	AB	
R21	Resistor	Composition	33 K 1 W 10%	AB	
R22	Potentiometer	Linear Taper	25K, 2 W	O	CU2531
R23	Resistor	Composition	15 K 1 W 10%	AB	
R24	Resistor	Composition	51 K 1/2 W 5%	AB	
R25	Resistor	Composition	1 Meg 1/2 W 10%	AB	
R26	Resistor	Composition	120 K 1 W 10%	AB	
R27	Resistor	Composition	120 K 1 W 10%	AB	
R28	Resistor	Composition	2.2 K 1 W 10%	AB	
R29	Potentiometer		10 K 2 W	O	CLU-1031
R30	Resistor	Composition	2.2 Meg 1/2 W 10%	AB	
R31	Resistor	Composition	2.2 K 1 W 10%	AB	
R32	Resistor	Composition	3.3 K 1/2 W 10%	AB	
R33	Resistor	Composition	1 Meg 1/2 W 10%	AB	
R34	Resistor	Composition	120 K 1 W 10%	AB	
R35	Resistor	Composition	2.2 K 1 W 10%	AB	
R36	Resistor	Composition	1 Meg 1/2 W 10%	AB	
R37	Resistor	Composition	1.5 K 1 W 10%	AB	
R38	Resistor	Composition	33 K 1 W 10%	AB	
R39	Potentiometer	Inverse Log	50 K 2 W	O	CB5031
R40	Resistor	Composition	36K 2 W 5%	AB	
R41	Resistor	Composition	6.8 K 1 W 10%	AB	
R42	Resistor	Composition	1 Meg 1 W 10%	AB	
R43	Resistor	Composition	470 ohms 1 W 10%	AB	
R44	Resistor	Composition	100 K 1 W 10%	AB	
R45	Resistor	Composition	330 K 1 W 10%	AB	
R46	Potentiometer	Linear Taper	100 K 2 W	O	CLU-1041

SCHEMATIC DESIG.	DESCRIPTION			MANUFACTURER (SEE CODE) AND MANUFACTURE'S PART NO.	
R47	Resistor	Composition	100K 1W 10%	AB	
R48	Potentiometer	Linear Taper	100K 2W	O	CLU-1041
R49	Potentiometer	Linear Taper	100K 2W	O	CLU-1041
R50	Resistor	Composition	100K 1/2W 1%	WEL	C12-500K
R51	Resistor	Composition	82K 1W 10%	AB	
R52	Potentiometer	Linear Taper	10K 2W	O	CLU-1031
R53	Resistor	Composition	82K 1W 10%	AB	
R54	Potentiometer	Linear Taper	10K 2W	O	CLU-1031
R55	Potentiometer	Linear	1M 2W	O	CLU-1052
R56	Resistor	Wire-Wound	7.5K 10W	O	Brown Devil
R57	Potentiometer	Wire-Wound	100 ohm 4W	MA	M100PK
R58	Resistor	Composition	100K 1/2W 5%	AB	
R59	Resistor	Composition	33K 1/2W 5%	AB	
R60	Resistor	Composition	18K 2W 10%	AB	
R61	Resistor	Composition	33K 1/2W 5%	AB	
R62	Resistor	Composition	100K 1/2W 5%	AB	
R63	Resistor	Composition	10K 1W 10%	AB	
R64	Resistor	Composition	120K 1W 10%	AB	
R65	Potentiometer	Linear	1M 2W	O	CLU-1052
R66	Resistor	Composition	100K 1W 10%	AB	
R67	Resistor	Composition	100K 1/2W 1%	WEL	C12-500K
R68	Resistor	Wire-wound	5K 5W	O	Brown Devil
R69	Potentiometer	Wire-Wound	10 ohms 4W	MA	M10PK
S1	Switch	Rotary - Shorting	1 Pole 5 Position	CRL	2500
S2	Switch	Rotary - Shorting	1 Pole 2 Position	CRL	2500
S3	Switch	Rotary - Shorting	1 Pole 3 Position	CRL	2500
S4	Switch	Rotary - Shorting	2 Pole 4 Position	CRL	2511
S5	Switch	Rotary - Shorting	1 Pole 2 Position	CRL	2500
T1	Transformer	Power		CH	P855 PSR55
T2	Transformer	Filament		T	F-18-A
TB2	Barrier Strip	12 contact		CJ	12-142Y

S-12-D SERVO AMPLIFIER (Cont'd) SERIAL NO._____

SCHEMATIC DESIG.	DESCRIPTION			MANUFACTURER (SEE CODE) AND MANUFACTURER'S PART NO.	
V1	Tube	6SL7-GT		RCA	
V2	Tube	6SL7-GT		RCA	
V3	Tube	6SL7-GT		RCA	
V4	Tube	6SL7-GT		RCA	
V5	Tube	6SL7-GT		RCA	
V6	Tube	5Y3GT		RCA	
V7	Tube	0C3/VR105		RCA	
V8	Tube	6SH7		RCA	
V9	Tube	6Y6G		RCA	
V10	Tube	0B2		RCA	
X1	Socket	Tube	Octal	AMP	77MIP-8T
X2	Socket	Tube	Octal	AMP	77MIP-8T
X3	Socket	Tube	Octal	AMP	77MIP-8T
X4	Socket	Tube	Octal	AMP	77MIP-8T
X5	Socket	Tube	Octal	AMP	77MIP-8T
X6	Socket	Tube	Octal	AMP	77MIP-8T
X7	Socket	Tube	Octal	AMP	77MIP-8T
X8	Socket	Tube	Octal	AMP	77MIP-8T
X9	Socket	Tube	Octal	AMP	77MIP-8T
X10	Socket	Tube	7 Pin	CJ	7XM1
	Tube Shield		7 Pin 2-1/4"	ELCO	PS-102U03
	Insert	Tube Shield	Heat Dissipating	ELCO	931

MP MASTER
MA34255